

FIG.1

METHOD OF ACCESSING DEFECT INFORMATION  
(STEP 1) MPU DESIGNATES A TARGET ADDRESS TO DF.

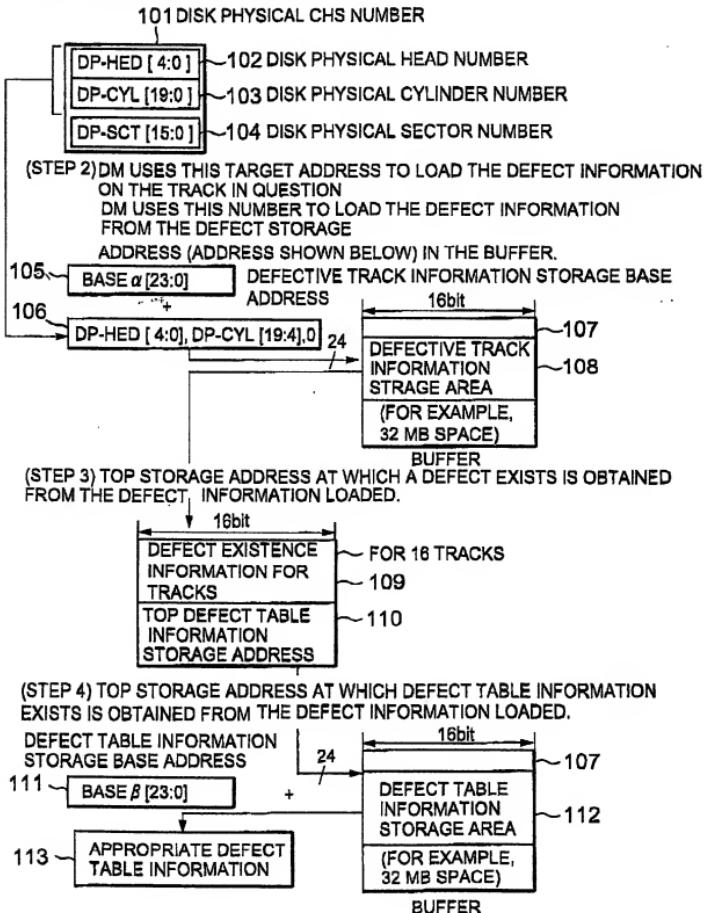
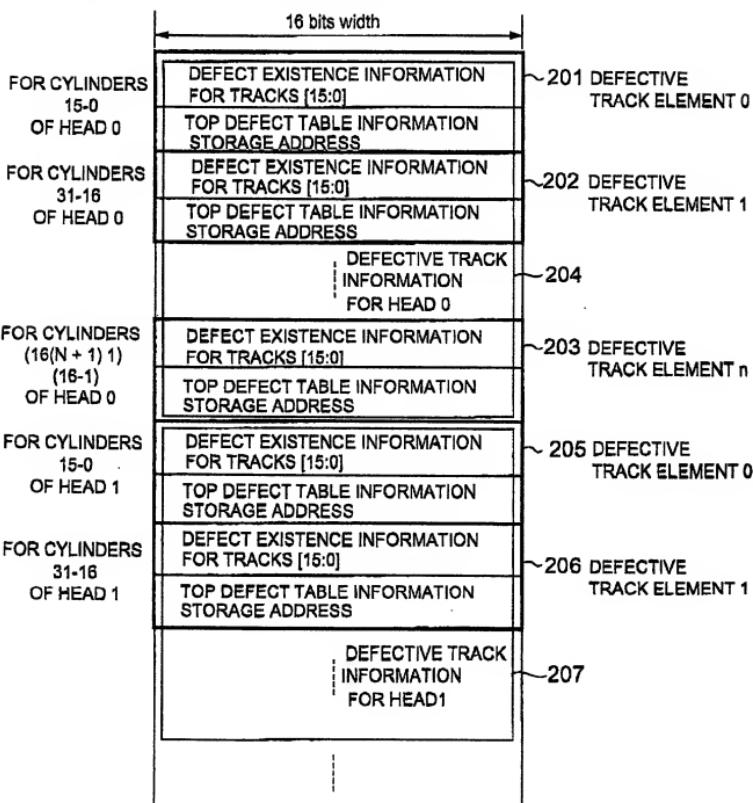


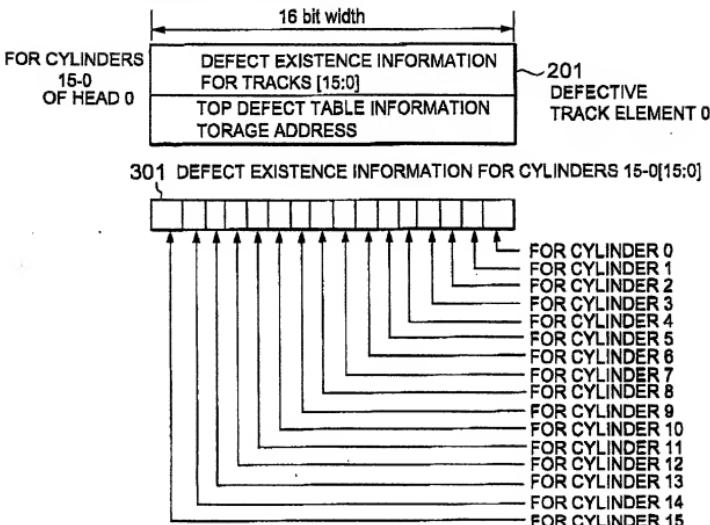
FIG.2

## FORMAT OF DEFECTIVE TRACK INFORMATION STORAGE AREA (TYPE 1)



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FIG.3

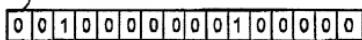
EXAMPLE OF FORMAT OF DEFECTIVE ELEMENT INFORMATION  
FOR TRACKS (TYPE 1)

## FIG.4

EXAMPLE OF FORMAT OF DEFECTIVE TABLE INFORMATION  
STORAGE ADDRESS (TYPE 1)

401 DEFECT EXISTENCE INFORMATION FOR CYLINDERS  
15-0[15:0]

FOR CYLINDERS 15-0



OF HEAD 0

DEFECT EXISTS  
AT CYLINDER 5  
DEFECT EXISTS  
AT CYLINDER 13

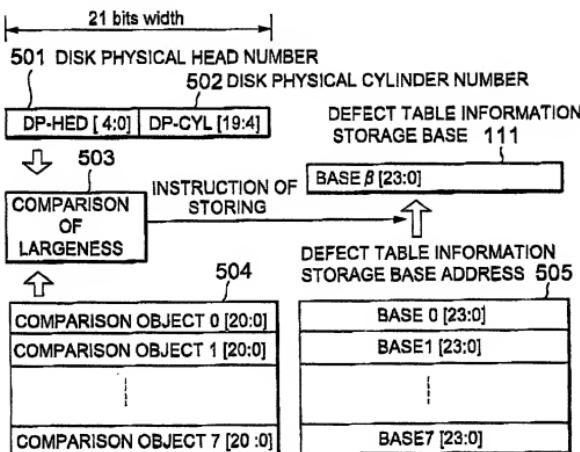
402 MINIMUM DEFECT TABLE INFORMATION  
STORAGE ADDRESS FOR DEFECT EXISTENCE  
INFORMATION



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FIG.5

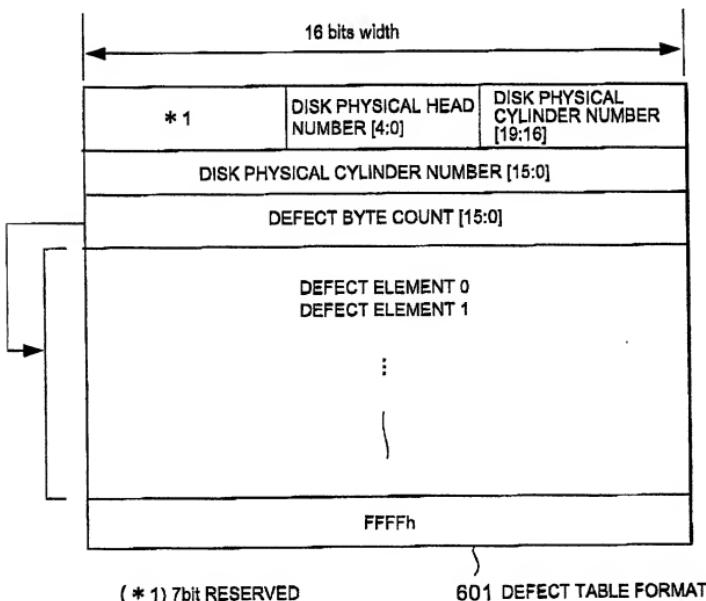
## SELECTION OF ADDRESS BASE FOR THE DEFECT TABLE INFORMATION STORAGE AREA



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FIG.6

## FORMAT OF DEFECT TABLE INFORMATION STORAGE AREA (TYPE 1)

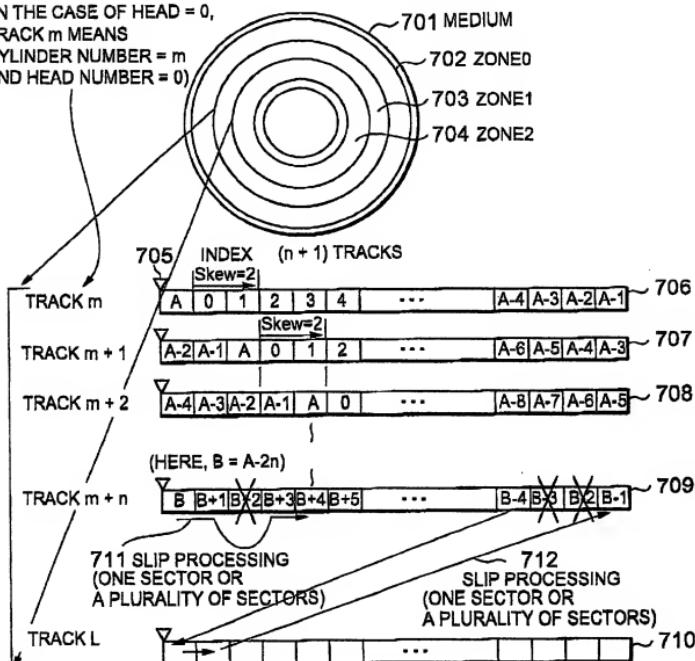


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FIG.7

## SECTOR ALLOCATION MAP INCLUDING DEFECTS

(IN THE CASE OF HEAD = 0,  
TRACK m MEANS  
CYLINDER NUMBER = m  
AND HEAD NUMBER = 0)



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## FIG.8

## INFORMATION REQUIRED FOR A DEFECT ELEMENT

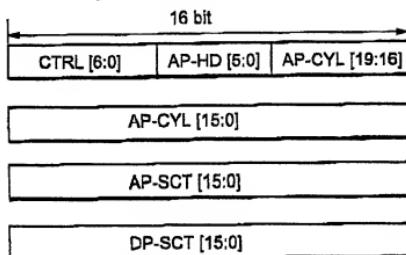
KIND OF DEFECT INFORMATION	CONTENTS
(1) SKIP INFORMATION	1) DISK PHYSICAL SECTOR NUMBER (DP-SCT [19:0]) AT WHICH A DEFECT EXISTS. 2) DISK PHYSICAL SECTOR NUMBER OF SUBSTITUTE (AP-CYL [19:0], AP-HED[4:0], AP-SCT [15:0]) 3) THE NUMBER OF SECTORS TO BE SKIPPED SUCCESSIVELY (DP-SCTCNT[15:0])
(2) SLIP INFORMATION	1) DISK PHYSICAL NUMBER (DP-SCT[15:0] AT WHICH A DEFECT EXISTS. 2) THE NUMBER OF SECTORS TO BE SLIPPED SUCCESSIVELY (ADP-SECNUM[15:0])
(3) END SECTOR INFORMATION	1) END SECTOR NUMBER (DP-SCT[15:0]) OF THE TRACK CONCERNED WHEN THE END SECTOR IS UNUSABLE AS A DEFECTIVE SECTOR, THE USABLE END DISK PHYSICAL SECTOR NUMBER IN THE TRACK IS DESIGNATED

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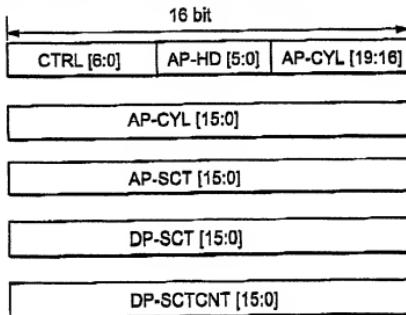
## FIG.9

## FORMAT OF DEFECT ELEMENT (FIRST)

## (1) SKIP OF ONE SECTOR (4 W)



## (2) SKIP OF SUCCESSIVE SECTORS (5 W)

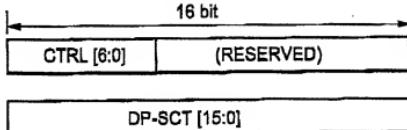


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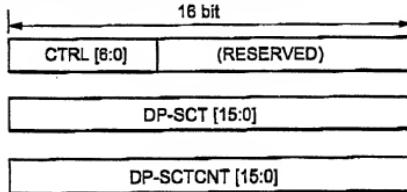
# FIG.10

## FORMAT OF DEFECT ELEMENT (SECOND)

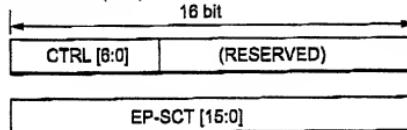
### (3) SLIP OF ONE SECTOR (2 W)



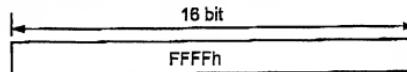
### (4) SLIP OF SUCCESSIVE SECTORS (3 W)



### (5) END SECTOR (2 W)



### (6) BOUNDARY OF THE DEFECT TABLE (1 W)

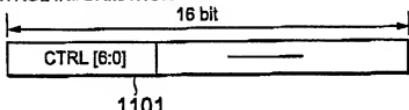


10000000000000000000000000000000

FIG. 11

## FORMAT OF CONTROL INFORMATION

**(1) CONTROL INFORMATION**



CTRI [6]: END OF SECTOR

**1: END OF SECTOR**

1. END SELECT

**INDICATION OF SKIP OR STOP**

**INDICATIONS**

1. SKIP, 0. SLIP  
CTR1 [4]: SEQUENTIAL

## INDICATION OF SUCCESSIVE SECTORS PROCESSING

## 1: SUCCESSIVE SECTOR PROCESSING, 0: ONE SECTOR PROCESSING

#### CTRI [3]: SPARE ON TRACK

INDICATION IF A SUBSTITUTE OF THE DEFECTIVE SECTOR EXISTS

INDICATION IF A SUBSTITUTION IS MADE ON THE CURRENT TRACK

## ON THE CURRENT TRACK 1. CURRENT TRACK: AN

1: CURRENT TRACK, 0: ANOTHER TRACK  
-1: (RESERVED)

CTRL [2]: (RESERVED)

CTRL [1]: (RESERVED)

CTRL [0] : (RESERVED)

FIG.12

## CONFIGURATION OF ELECTRONIC CIRCUIT FOR DISK APPARATUS 12/12

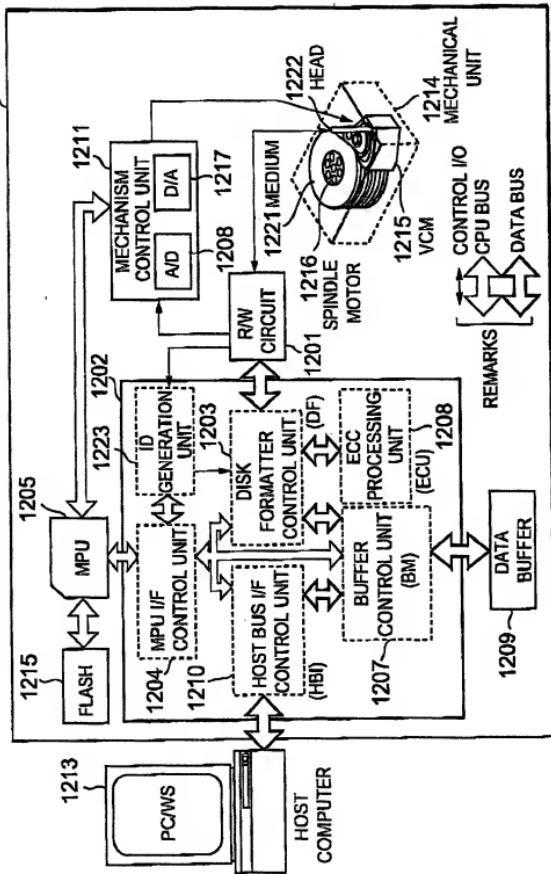
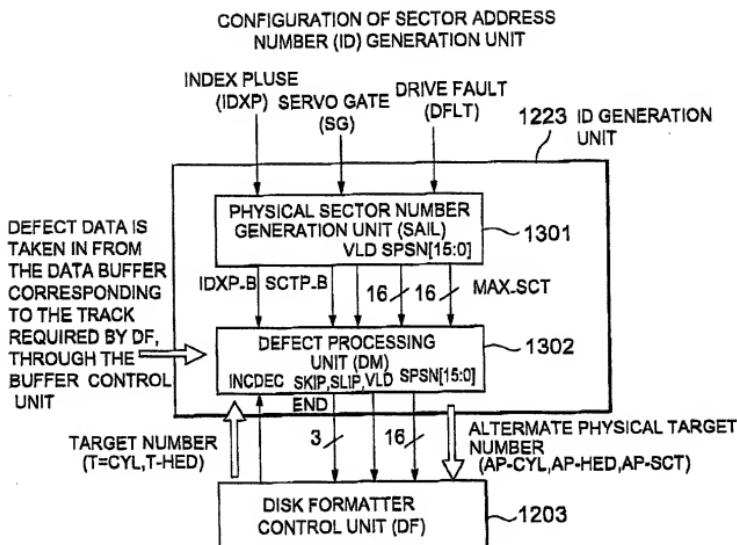


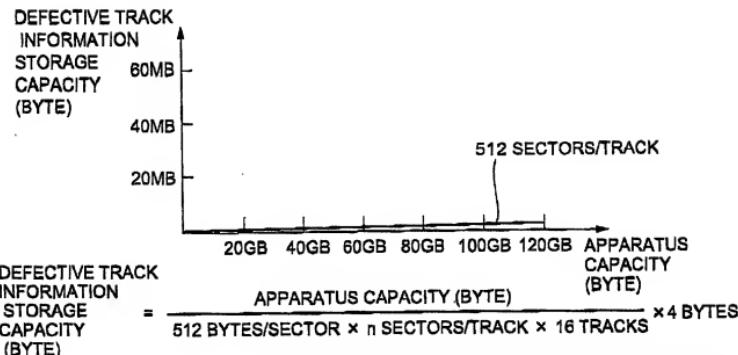
FIG.13



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FIG. 14

APPARATUS CAPACITY AND TRACK INFORMATION  
STORAGE CAPACITY (TYPE 1)

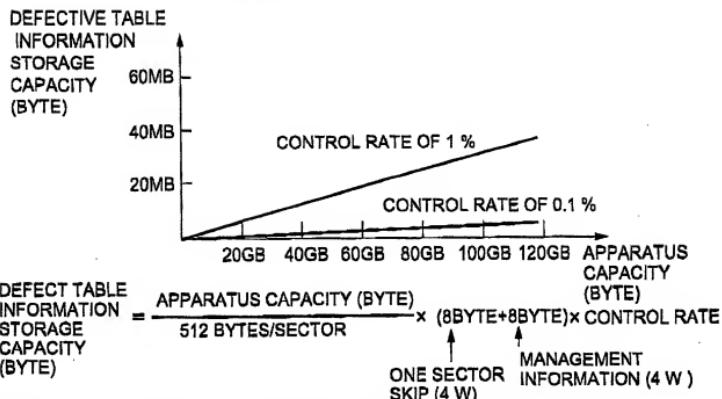


APPARATUS CAPACITY	TOTAL SECTOR COUNT	DEFECTIVE TRACK INFORMATION				STORAGE CAPACITY
		SECTOR COUNT PER TRACK (n: SECTORS/TRK)				
		512	1024	2048	4096	
20GB	39MSECTORS	19.1KB	9.5KB	4.8KB	2.4KB	
40GB	78MSECTORS	38.1KB	19.1KB	9.5KB	4.8KB	
60GB	117MSECTORS	57.2KB	28.6KB	14.3KB	7.2KB	
80GB	156MSECTORS	76.3KB	38.1KB	19.1KB	9.5KB	
100GB	195MSECTORS	95.4KB	47.7KB	23.8KB	11.9KB	
120GB	234MSECTORS	114KB	57.2KB	28.6KB	14.3KB	

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FIG. 15

APPARATUS CAPACITY AND DEFECT TABLE  
INFORMATION STORAGE CAPACITY (TYPE1)



CONTROL RATE = CONTROLLED NUMBER OF DEFECTIVE SECTORS/NUMBER OF ALL SECTORS IN APPARATUS

**(a) CONTROL RATE OF 0.1 %**

APPARATUS CAPACITY	TOTAL SECTOR COUNT	DEFECT TABLE INFORMATION STORAGE CAPACITY
20GB	39MSECTORS	39 K DEFECTIVE SECTORS (625 KB)
40GB	78MSECTORS	78 K DEFECTIVE SECTORS (1.3MB)
60GB	117MSECTORS	117K DEFECTIVE SECTORS (1.9MB)
80GB	156MSECTORS	156K DEFECTIVE SECTORS (2.5MB)
100GB	195MSECTORS	195K DEFECTIVE SECTORS (3.1MB)
120GB	234MSECTORS	234K DEFECTIVE SECTORS (3.8MB)

(b) CONTROL RATE OF 1%

APPARATUS CAPACITY	TOTAL SECTOR COUNT	DEFECT TABLE INFORMATION STORAGE CAPACITY
20GB	39MSECTORS	390 K DEFECTIVE SECTORS (6.3MB)
40GB	78MSECTORS	780 K DEFECTIVE SECTORS (13MB)
60GB	117MSECTORS	1.2M DEFECTIVE SECTORS (19MB)
80GB	156MSECTORS	1.6M DEFECTIVE SECTORS (25MB)
100GB	195MSECTORS	2.0M DEFECTIVE SECTORS (31MB)
120GB	234MSECTORS	2.3M DEFECTIVE SECTORS (38MB)

FIG.16

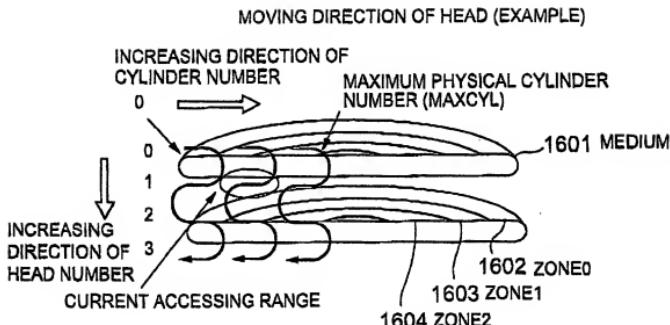


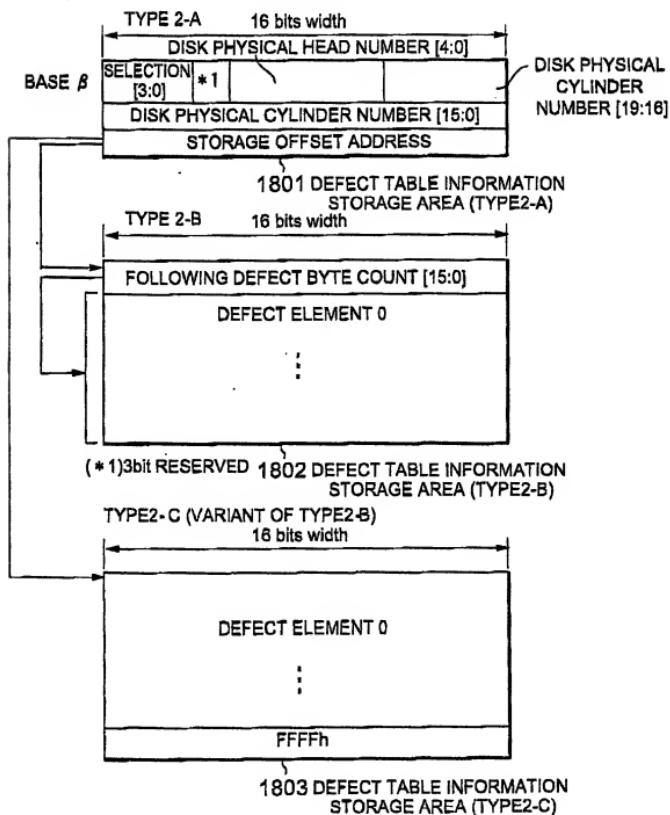
FIG.17

RELATION BETWEEN MOVING DIRECTION OF HEAD, CYLINDER AND HEAD (EXAMPLE)

	CYLINDER NUMBER 0-19	CYLINDER NUMBER 20-39	CYLINDER NUMBER 40-59
HEAD NUMBER 0	→	→	→
HEAD NUMBER 1	←	→	←
HEAD NUMBER 2	→	→	→
HEAD NUMBER 3	←	→	←

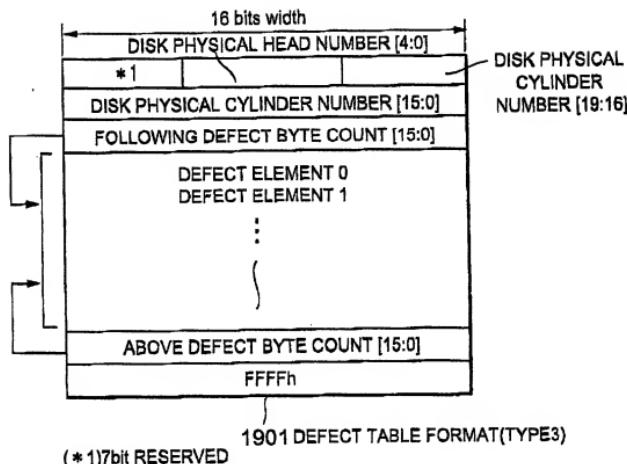
CURRENT ACCESSING RANGE

FIG.18

FORMAT OF DEFECT TABLE INFORMATION  
STORAGE AREA (TYPE2)

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FIG.19

FORMAT OF DEFECT TABLE INFORMATION  
STORAGE AREA (TYPE3)

10000000000000000000000000000000

FIG.20

COMPARISON OBJECT 504

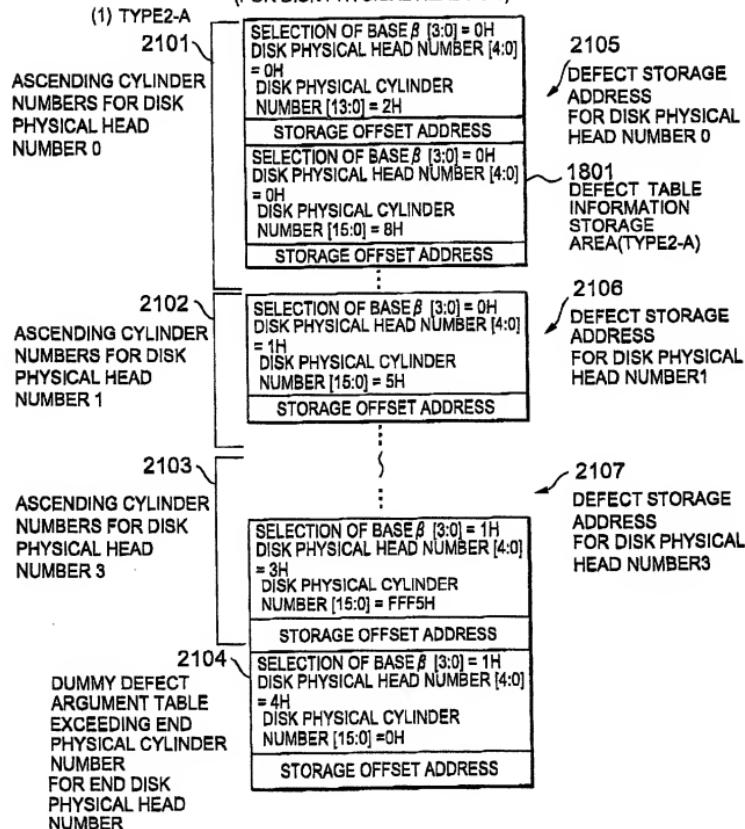
DEFECT TABLE BASE  
ADDRESS 505

TRACK NUMBER 0-100	1000H
TRACK NUMBER 101-500	5000H
TRACK NUMBER 501-800	8000H
...	...

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FIG.21

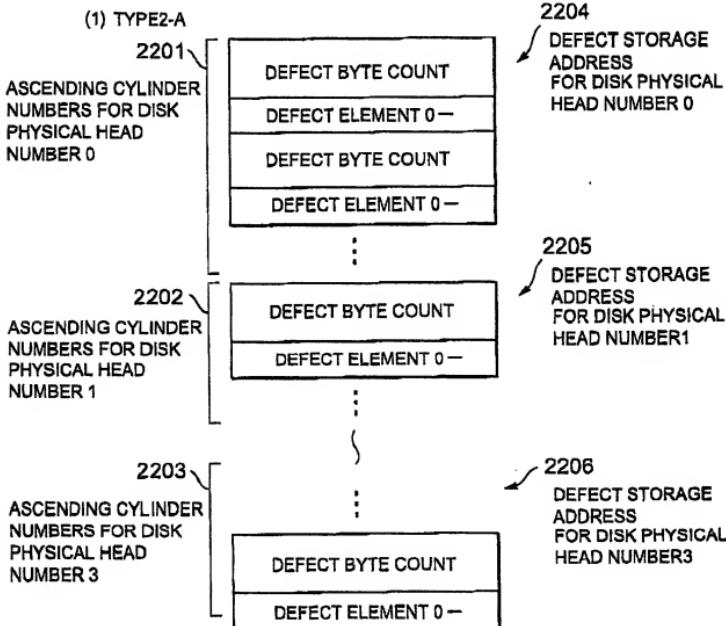
FORMAT OF DEFECT TABLE INFORMATION STORAGE AREA (TYPE2-A)  
(FOR DISK PHYSICAL HEADS 0-3)



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FIG.22

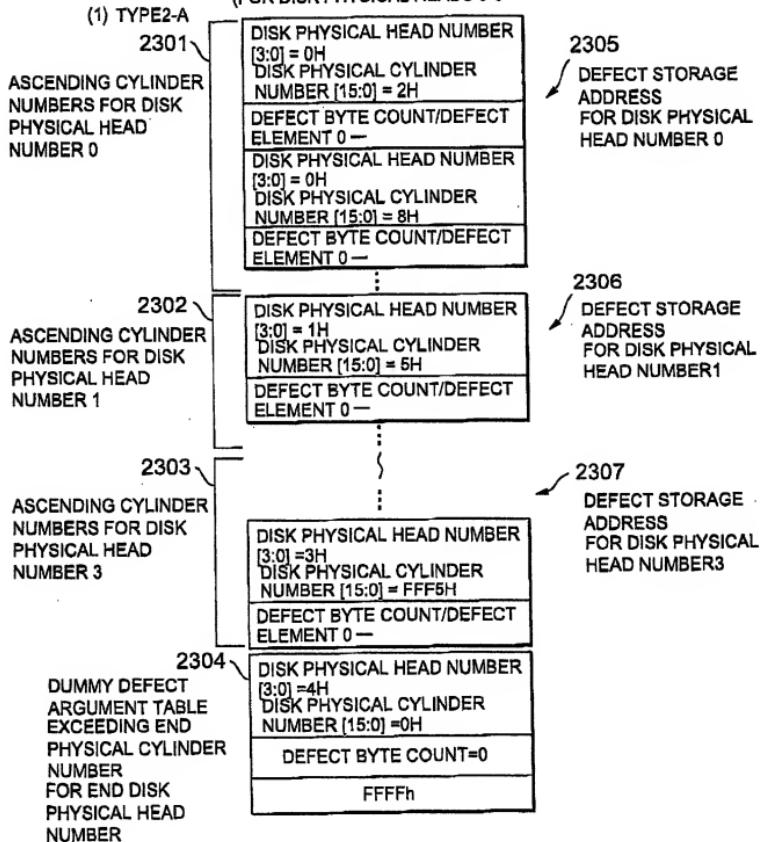
FORMAT OF DEFECT TABLE INFORMATION STORAGE AREA (TYPE2-B)  
 (FOR DISK PHYSICAL HEADS 0-3)



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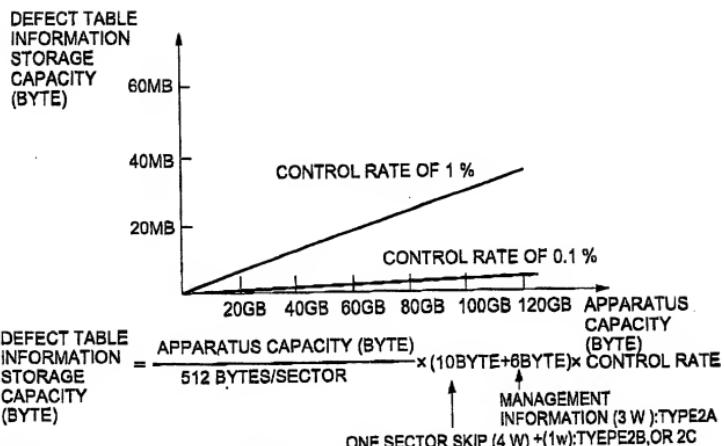
FIG.23

**FORMAT OF DEFECT TABLE INFORMATION STORAGE AREA (TYPE3 )**  
**(FOR DISK PHYSICAL HEADS 0-3**



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FIG.24

APPARATUS CAPACITY AND DEFECT TABLE  
INFORMATION STORAGE CAPACITY (TYPE2)

CONTROL RATE = CONTROLLED NUMBER OF DEFECTIVE SECTORS / NUMBER OF ALL SECTORS IN APPARATUS

(a) CONTROL RATE OF 0.1 %

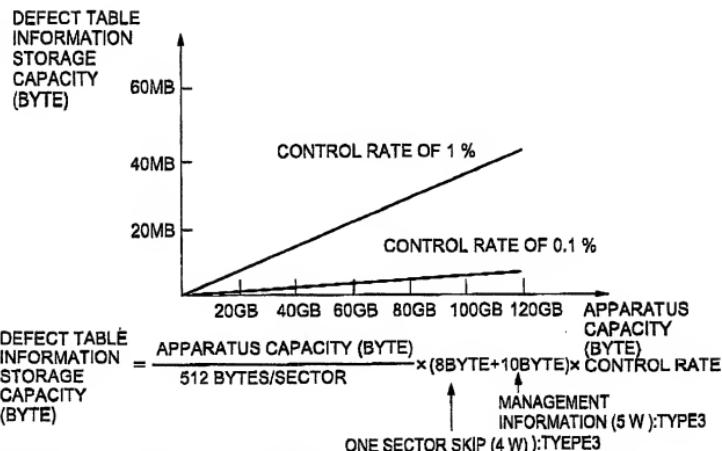
APPARATUS CAPACITY	TOTAL SECTOR COUNT	DEFECT TABLE INFORMATION STORAGE CAPACITY
20GB	38M SECTORS	39 K DEFECTIVE SECTORS (625KB)
40GB	78M SECTORS	78 K DEFECTIVE SECTORS (1.3MB)
60GB	117M SECTORS	117K DEFECTIVE SECTORS (1.9MB)
80GB	156M SECTORS	156K DEFECTIVE SECTORS (2.5MB)
100GB	195M SECTORS	195K DEFECTIVE SECTORS (3.1MB)
120GB	234M SECTORS	234K DEFECTIVE SECTORS (3.8MB)

(b) CONTROL RATE OF 1 %

APPARATUS CAPACITY	TOTAL SECTOR COUNT	DEFECT TABLE INFORMATION STORAGE CAPACITY
20GB	39M SECTORS	390 K DEFECTIVE SECTORS (6.3MB)
40GB	78M SECTORS	780 K DEFECTIVE SECTORS (13MB)
60GB	117M SECTORS	1.2M DEFECTIVE SECTORS (19MB)
80GB	156M SECTORS	1.6M DEFECTIVE SECTORS (25MB)
100GB	195M SECTORS	2.0M DEFECTIVE SECTORS (31MB)
120GB	234M SECTORS	2.3M DEFECTIVE SECTORS (38MB)

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FIG.25

APPARATUS CAPACITY AND DEFECT TABLE  
INFORMATION STORAGE CAPACITY (TYPE3)

CONTROL RATE = CONTROLLED NUMBER OF DEFECTIVE SECTORS/NUMBER OF ALL SECTORS IN APPARATUS

(a) CONTROL RATE OF 0.1 %

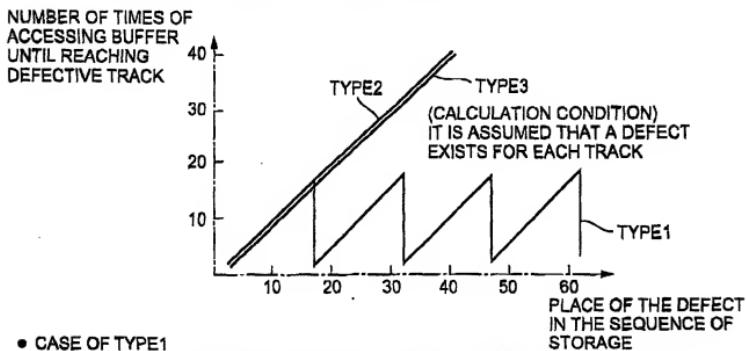
APPARATUS CAPACITY	TOTAL SECTOR COUNT	DEFECT TABLE INFORMATION STORAGE CAPACITY
20GB	39M SECTORS	39 K DEFECTIVE SECTORS (700KB)
40GB	78M SECTORS	78 K DEFECTIVE SECTORS (1.4MB)
60GB	117M SECTORS	117K DEFECTIVE SECTORS (2.1MB)
80GB	156M SECTORS	156K DEFECTIVE SECTORS (2.8MB)
100GB	195M SECTORS	195K DEFECTIVE SECTORS (3.5MB)
120GB	234M SECTORS	234K DEFECTIVE SECTORS (4.2MB)

(b) CONTROL RATE OF 1 %

APPARATUS CAPACITY	TOTAL SECTOR COUNT	DEFECT TABLE INFORMATION STORAGE CAPACITY
20GB	39M SECTORS	390 K DEFECTIVE SECTORS (7MB)
40GB	78M SECTORS	780 K DEFECTIVE SECTORS (14MB)
60GB	117M SECTORS	1.2M DEFECTIVE SECTORS (21MB)
80GB	156M SECTORS	1.6M DEFECTIVE SECTORS (28MB)
100GB	195M SECTORS	2.0M DEFECTIVE SECTORS (35MB)
120GB	234M SECTORS	2.3M DEFECTIVE SECTORS (42MB)

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## FIG.26

COMPARISON OF NUMBERS OF TIMES OF ACCESSING BUFFER  
REQUIRED UNTIL REACHING TARGET DEFECTIVE TRACK

- CASE OF TYPE1  
(PROCEDURE 1) ACCESS TO DEFECTIVE TRACK INFORMATION STORAGE AREA  
(PROCEDURE 2) ACCESS TO TOP OF DEFECT TABLE INFORMATION STORAGE AREA  
(PROCEDURE 3) ACCESS TO DEFECT TABLE INFORMATION STORAGE AREA  
(2ND THROUGH 16TH AT MAXIMUM; IN THE SEQUENCE OF STORAGE)
- CASE OF TYPE2  
(PROCEDURE 1) ACCESS TO DEFECTIVE TRACK INFORMATION STORAGE AREA  
(IN ORDER OR STORAGE)  
(PROCEDURE 2) ACCESS TO DEFECT TABLE INFORMATION
- CASE OF TYPE3  
(PROCEDURE 1) ACCESS TO DEFECTIVE TRACK INFORMATION STORAGE AREA  
(IN ORDER OF STORAGE)

DEFECTIVE TRACK STORAGE NUMBER AND THE NUMBER  
OF TIMES OF ACCESSING THE BUFFER

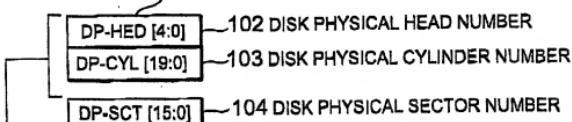
PLACE OF THE DEFECTIVE TRACK IN THE SEQUENCE OF STORAGE	NUMBER OF TIMES OF ACCESSING THE BUFFER		
	TYPE1	TYPE2	TYPE3
1	2	2	1
2	3	3	2
3	4	4	3
...			
16	17	17	16
17	2	18	17
18	3	19	18
...			
$n$	RESIDUE ( $n/16$ ) +1	$n+1$	$n$

FIG.27

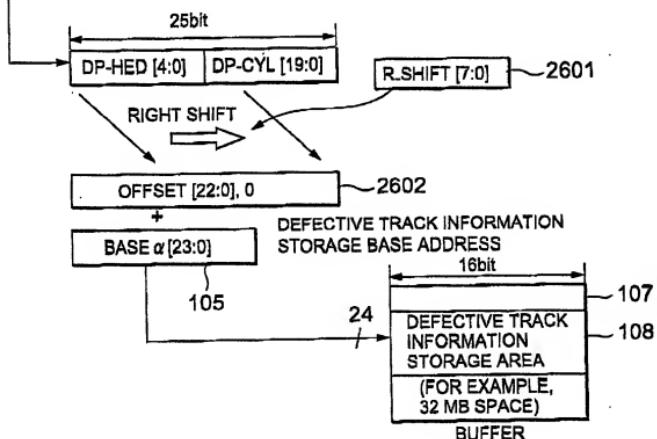
METHOD OF GENERATING OFFSET ADDRESS  
FOR DEFECTIVE TRACK INFORMATION (FIRST)

(STEP 1) MPU DESIGNATES A TARGET ADDRESS TO DF.

101 DISK PHYSICAL CHS NUMBER



(STEP 2) DM USES THIS TARGET ADDRESS TO LOAD THE DEFECT INFORMATION  
ON THE TRACK IN QUESTION.  
DM USES THIS NUMBER TO LOAD THE DEFECT INFORMATION FROM THE DEFECT  
STORAGE ADDRESS (ADDRESS SHOWN BELOW) IN THE BUFFER.



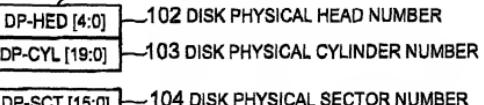
10006669-121001

FIG.28

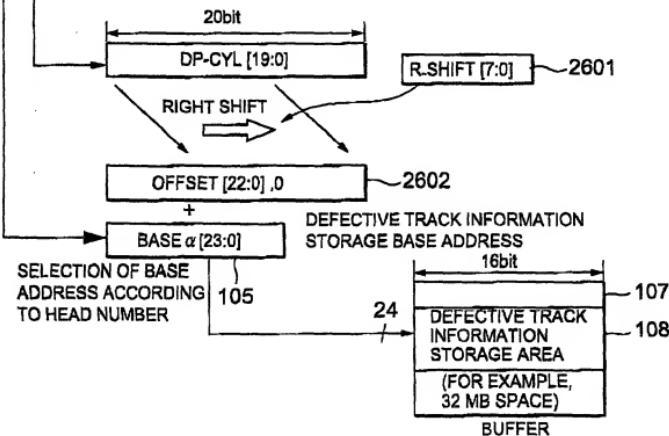
METHOD OF GENERATING OFFSET ADDRESS  
FOR DEFECTIVE TRACK INFORMATION (SECOND)

(STEP 1) MPU DESIGNATES A TARGET ADDRESS TO DF.

101 DISK PHYSICAL CHS NUMBER



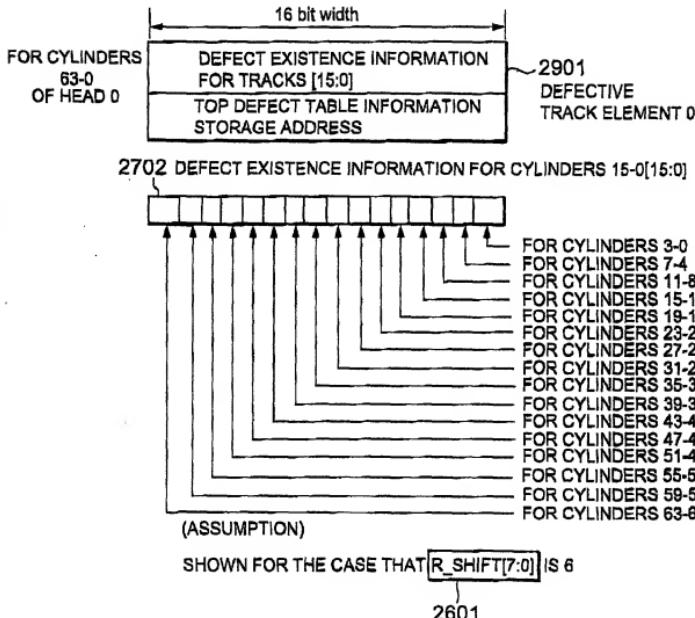
(STEP 2) DM USES THIS TARGET ADDRESS TO LOAD THE DEFECT INFORMATION ON THE TRACK IN QUESTION.  
DM USES THIS NUMBER TO LOAD THE DEFECT INFORMATION FROM THE DEFECT STORAGE ADDRESS (ADDRESS SHOWN BELOW) IN THE BUFFER.



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FIG.29

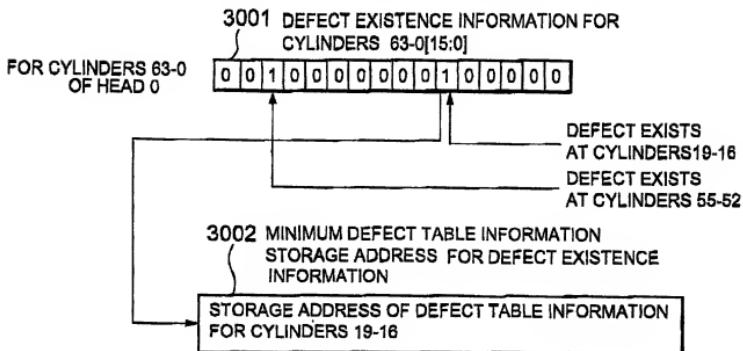
EXAMPLE OF FORMAT OF DEFECTIVE TRACK INFORMATION  
FOR TRACKS (TYPE 4)



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## FIG.30

EXAMPLE OF FORMAT OF DEFECTIVE TRACK INFORMATION  
STORAGE ADDRESS FOR TRACKS (TYPE4)



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FIG.31

## COMPARISON OF SYSTEMS

SYSTEM	TYPE 1	TYPE 2	TYPE 3	TYPE 4
WHOLE TRACK INFORMATION STORING	DEFECT TABLE INFORMATION STORING		DEFECT TABLE INFORMATION STORING	WHOLE TRACK INFORMATION COMPRESSING AND STORING
DEFECTIVE TRACK INFORMATION	ALL TRACKS	---		COMPRESSED AND FOR ALL TRACKS
DEFECT TABLE INFORMATION	DEFECTIVE TRACKS ONLY	DEFECTIVE TRACKS ONLY	SEARCHABLE FORWARD AND BACKWARD DEFECTIVE TRACKS	DEFECTIVE TRACKS ONLY
DEFECTIVE TRACK INFORMATION CAPACITY	$\alpha$	---	---	$\alpha/2(R^4)$
DEFECT TABLE INFORMATION CAPACITY	$\beta$	$1.1\beta$	$1.1\beta$	$\beta$
NECESSITY OF PUTTING DEFECT TABLES IN ORDER OF ADDRESS	YES	---	---	YES
NECESSITY OF PUTTING DEFECT TABLES IN ORDER OF ADDRESS	NO	YES	YES	NO
NECESSITY FOR FW TO KNOW STORAGE ADDRESS NUMBER OF TIMES OF ACCESSING BUFFER UNTIL REACHING TARGET DEFECT TABLE	YES	YES	NO	YES
	2 - 17	$n + 1$	$n$	$2 - 2^{(R+4)+1}$

(1) R IS RIGHT SHIFT AMOUNT

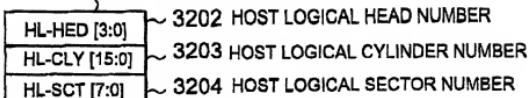
(2) n IS PLACE OF DEFECT IN SEQUENCE OF STORAGE, COUNTING FROM THE SMALLEST ADDRESS

(3)  $\alpha$  AND  $\beta$  ARE A CONSTANT FOR COMPARISON OF CAPACITY RATIO (BYTE COUNT) OF EACH TYPE

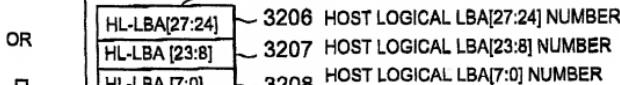
FIG.32

CONVERSION FROM HOST LOGICAL NUMBER  
TO DISK PHYSICAL NUMBER

3201 HOST LOGICAL CHS NUMBER



3205 HOST LOGICAL LBA NUMBER



3209 DISK PHYSICAL CHS NUMBER

